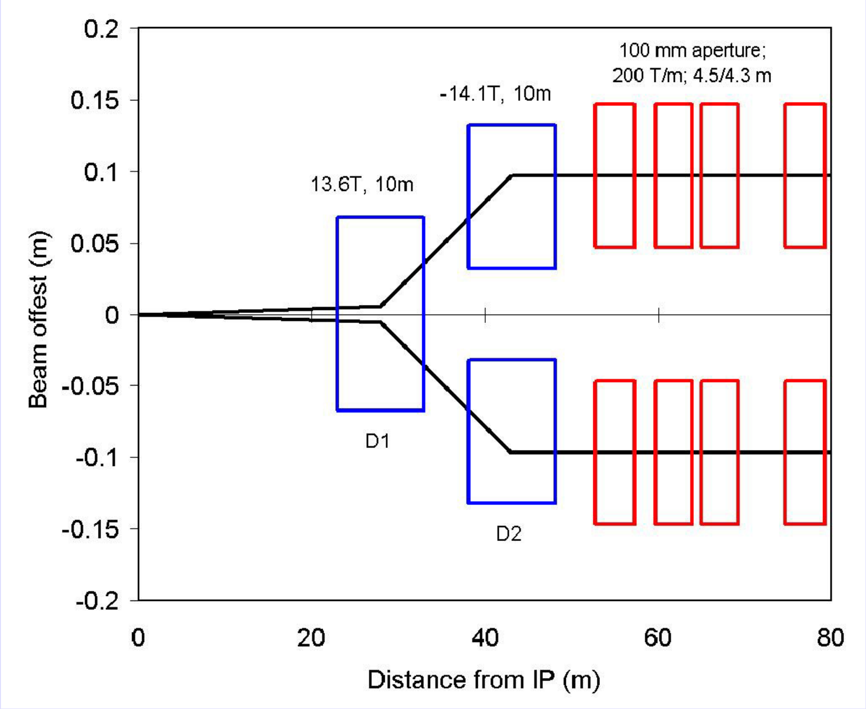
The LARP Dipole R&D Program - D1 only
Design Requirements

120 parasitic long range collisions may give a beam-beam interaction problem at higher than design beam intensities. A dipole first IR design is one way to try to minimize this problem. (Direct compensation with wires is also under active R&D at CERN). This also helps the triplets a little with centered beam



Design Requirements:

- High field ~14T (space)
- Large Aperture (beam separation)
- Field Quality (high beta lattice location)
- Beam heating (first active element from the IP)

Range of Conceptual Designs for D1

Two potential technical approaches, both based on Nb3Sn, have been considered. Essentially trading one set of problems for another in a complimentary fashion:

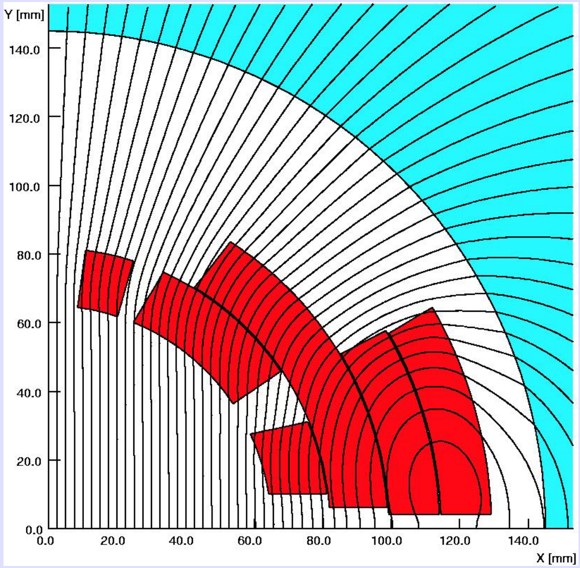
Cosine - theta

Issues well understood

Field quality O.K.

Large Aperture + High field = Large forces

Beam heating - quench/cryogenics



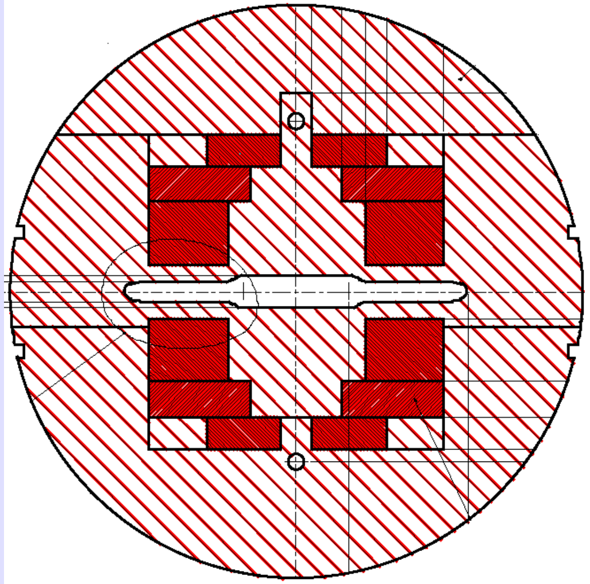
Block Magnet

Beam heating - quench/cryogenics

Asymmetric aperture

Field quality

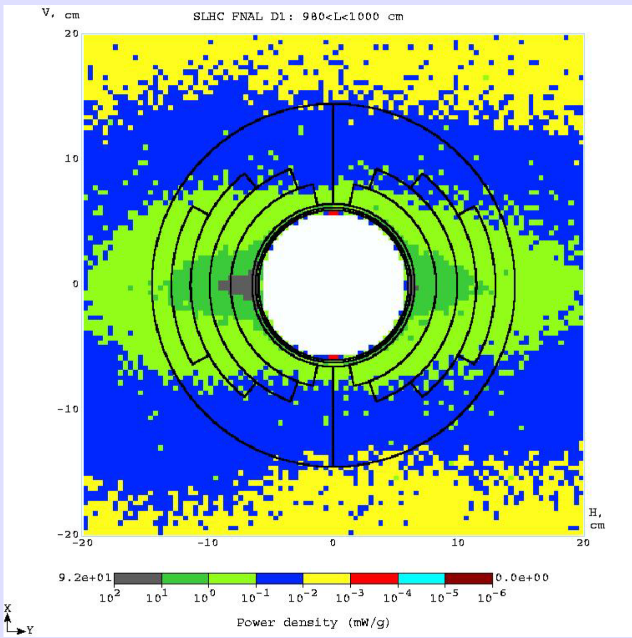
Issues not (well ?) understood

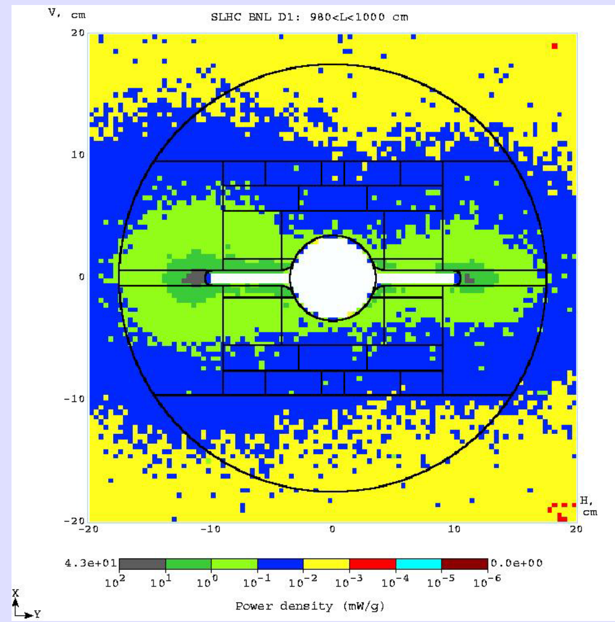


Mike Harrison

Beam Heating Requirements

We have made some crude MARS calculations assuming some plausible upstream shielding.



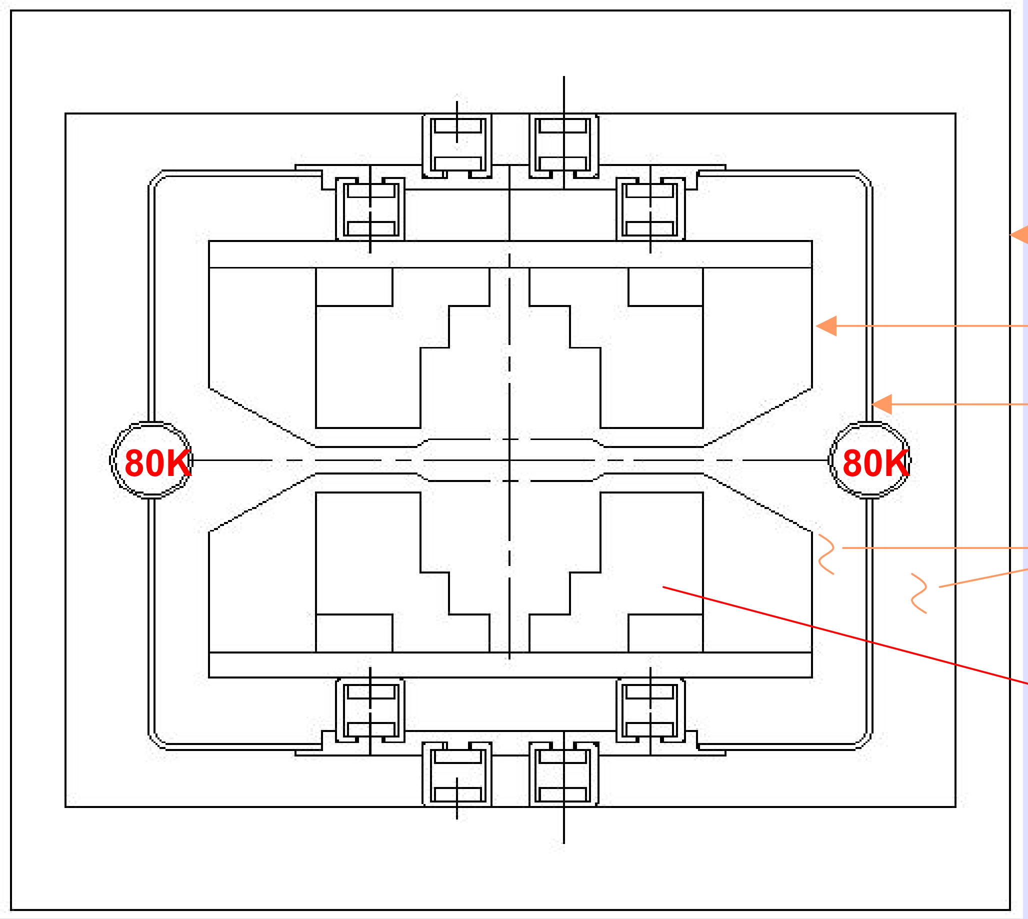


Both magnets receive about 3.5kW of beam heating ‼

Cosine theta gets 13mW/g into the coils - edgy

Block dipole gets about 1 mW/g

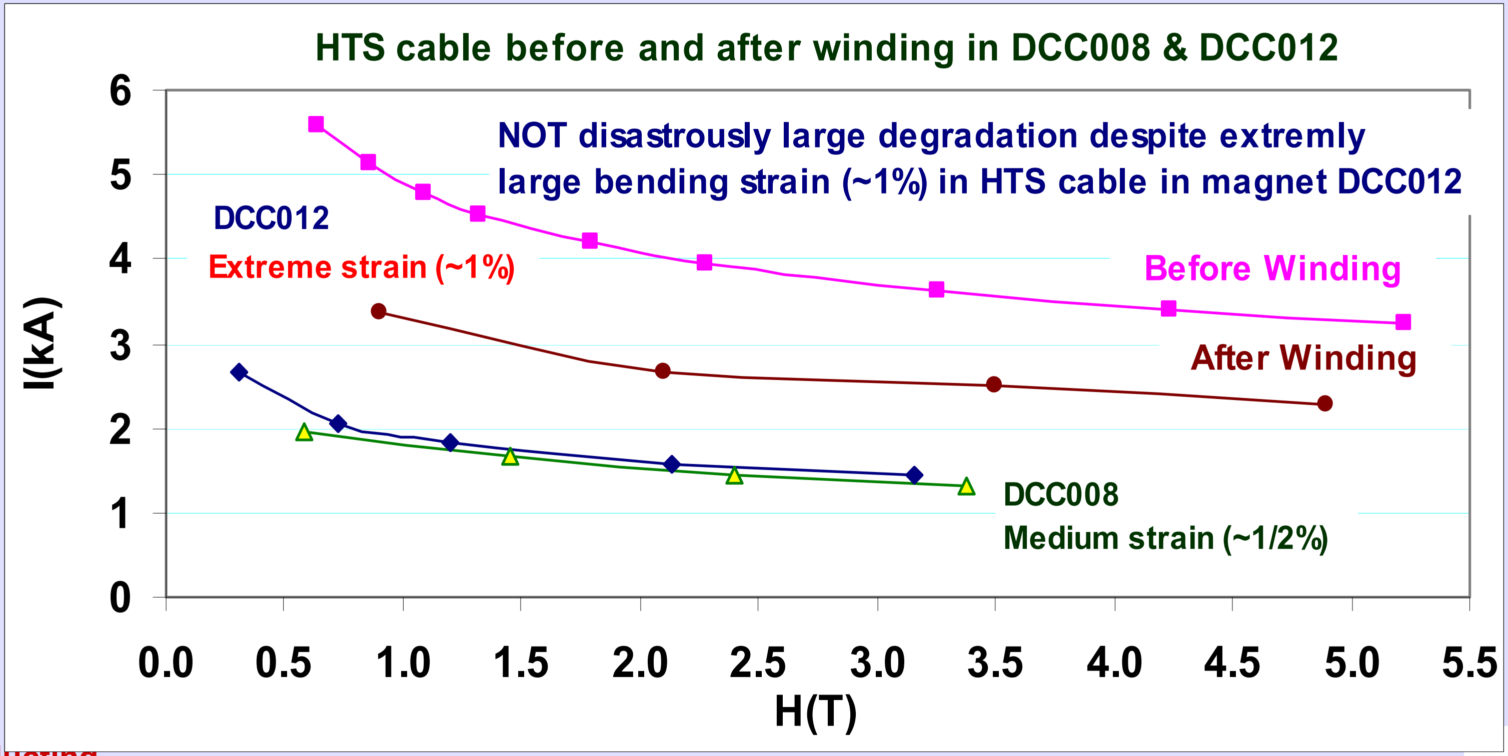
Heat Removal at Higher Temperatures



- This concept has the beam loss intercepted at 80K thus 3.5KW is not prohibitive

High Temperature Superconductors

- Insensitivity to operating temperature would be useful in such an environment (3.5KW)
- 10-turn coils test O.K. (LBL-Showa-BNL)
- Performance needs to increase by ~ factor of 3 from today



R&D Program - Common Issues

- Initial Phase would be to determine the viability of either approach with magnetic, mechanical and cryogenic calculations. Given the funding profile this is ~ 2 years. The base program keeps plugging away. We would keep an eye on the CERN beam-beam compensation experiments (Zimmerman et al)

- Common R&D issues
  - Nb_3Sn radiation resistance
  - Nb_3Sn quench properties
  - Coil cooling and heat removal
  - Mechanical forces
  - Insulating materials

R&D Program - Model Magnets

Possible development program with 4 models:

1. Field strength
   Can we achieve ~14T
2. Field strength with field quality - static and dynamic
   Can we achieve ~14T with acceptable field quality at injection, acceleration and storage
3. Heat load tolerance
   Can the magnet absorb the estimated energy deposition into the coils
4. Thermal performance
   Can the cryogenic system remove 3.5kW of DC heating. What is the steady state temperature profile

Relationship to the National Base Program

- High fields, large apertures, high beam losses: a relatively generic problem for next generation facilities
  - Nb3Sn development program applies to all variants.
  - Cosine-theta approach directly benefits from the Fermilab wind-and-react and react-and-wind programs.
  - Block dipole benefits from the LBL & BNL flat 10 turn coil programs.
  - The "Mokhov" national facility.

Funding and Manpower

- Tacit assumption is that this program is incremental. The question is incremental on what ?

Conclusions

- Dipole first is a challenging approach for future LHC IR's.
- Two distinct technical approaches which align well with the baseline national program in Nb3Sn.
- The issue of total beam power into the cryogenic system probably should be contemplated somewhat.
- Need to establish feasibility of D2's before actually starting to build anything associated with D1's.